Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information

Polyaniline/graphene hybrid film as an effective broadband electromagnetic shield

Ranjini R.Mohan[1], Sreekanth J.Varma[2], Muhammad Faisal[3], S.Jayalekshmi[1]*

[1]Division for Research in Advanced Materials, Department of Physics, Cochin University of Science and Technology, Kochi – 682 022, Kerala, India

[2]Department of Physics, Sanatana Dharma College, Alappuzha – 688 003, Kerala, India

[3]Department of Physics, PES Institute of Technology-Bangalore South Campus, Banglore-560100, Karnataka, India

*corresponding author: jayalekshmi@cusat.ac.in

Phone: +91-484-2577404

Polyaniline was synthesized by the self-stabilized dispersion polymerization of aniline monomer in the presence of HCl and chloroform (1:2 v/v) as detailed in the manuscript. APS was used as the initiator. The reaction was carried out, at -30^0C using dry ice-acetone mixture, with stirring for 4 hours. The resultant solution was filtered, washed and dried to obtain PANi in the powder form. Pure PANi films were prepared adopting the same method detailed in the manuscript without adding graphene nanoflakes.

Characterization:

1. *FTIR of pure PANi film*

The FTIR spectrum of pure PANi film prepared via self-stabilized dispersion is shown in figure S1.

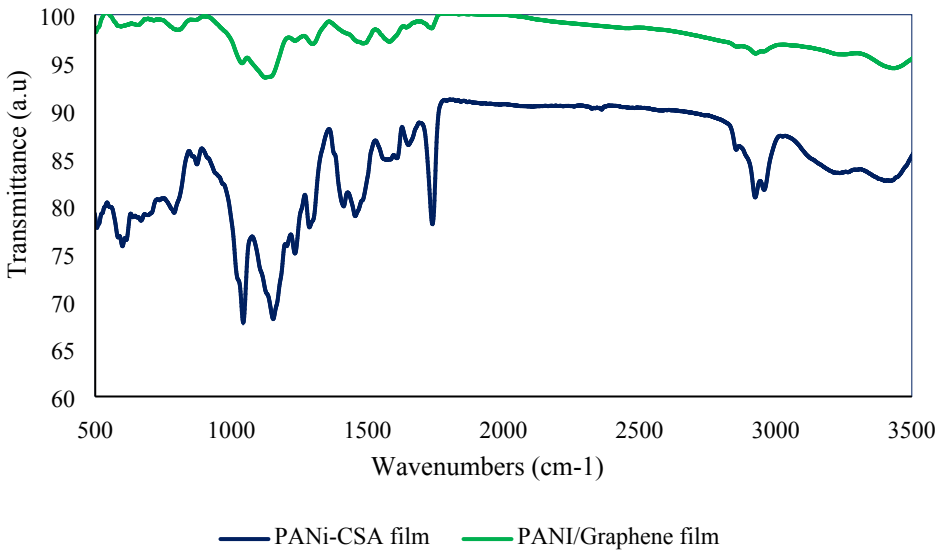

Figure S1: FTIR spectra of CSA doped PANi and PANi/graphene films

Both the spectra show all the signature vibrations of doped PANi as detailed in the manuscript. The relevant data on the FTIR of PANi/graphene film is discussed in the manuscript.

2. *XRD of PANi film*

The XRD of PANi film is shown in figure S2.

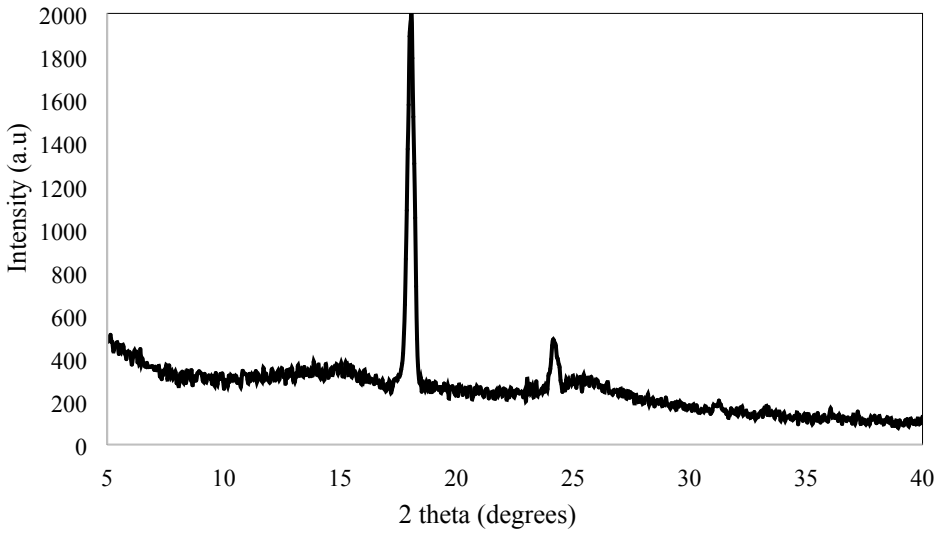

Figure S2: XRD spectrum of CSA doped PANi film

From figure S2, it can be clearly seen that the PANi film appear to be quite crystalline. All the signature peaks of PANi (around 13^0 and 25^0) are present in the XRD spectrum confirming the formation of doped PANi. Highly intense peak at 18^0 and another sharp peak at 24^0 can be seen in the figure indicating an ordered structure. In the XRD spectrum of PANi graphene film, the presence of graphene distorts the order among the PANi chains and hence the intense sharp peaks disappear. This occurs due to the formation of a homogeneous PANi layer on the graphene surface with enhanced surface area which is evident from the FESEM images of PANi/graphene films shown in the manuscript.

3. *Raman Spectrum of PANi film:*

The micro-Raman spectrum of PANi film is shown in figure S3. Two peaks can be seen at 1347 cm^{-1} and 1578 cm^{-1} which corresponds respectively to vibrations of the semiquinone radical and C=C stretching of the quinoid rings of PANi (reference cited in the manuscript). A small peak at 610 cm^{-1} and projection at 1180 cm^{-1} (merged with the 1347 cm^{-1} peak) can also be seen confirming the C-N-C torsion and the presence of C-H bending of the quinoid ring in the PANi film, respectively.

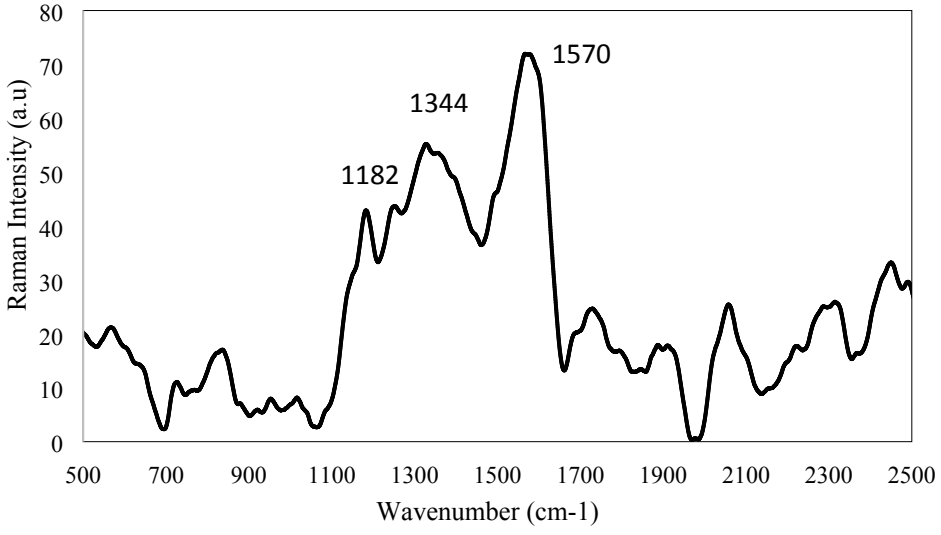

Figure S3: Micro-raman spectrum of PANi film

4. *EMI Shielding Effectiveness of PANi film:*

The EMI shielding effectiveness of PANi films were investigated following the same procedure detailed in the manuscript. The total shielding effectiveness of PANi films in the X-band is shown in figure S4. The SE_T values of the pure PANi film samples dominated by absorption were below -15dB in the X-band of the microwave spectrum. This kind of absorption dominated shielding is useful in stealth applications. But this SE value is not that high when compared to many other polyaniline composites and does not meet the commercial standards.

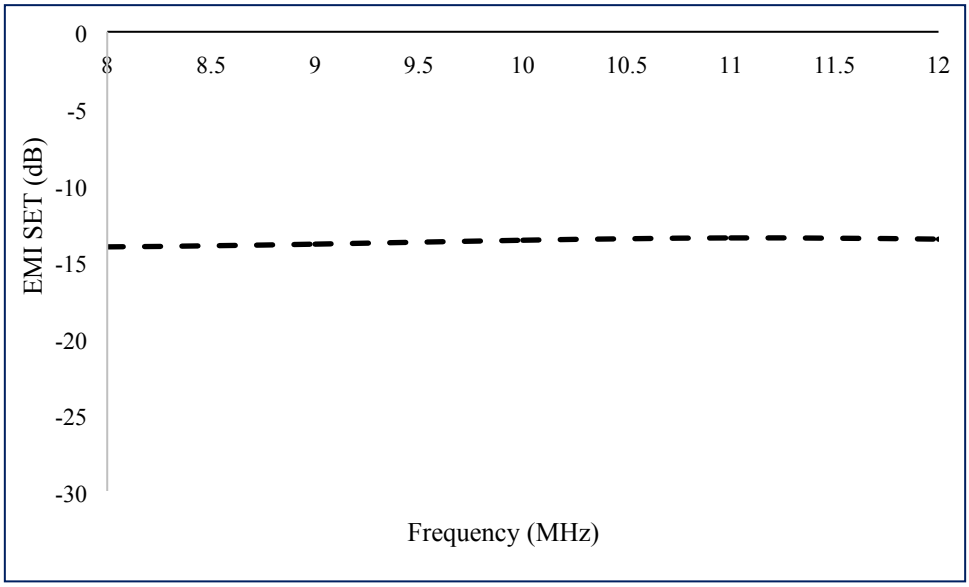

Figure S4: EMI SE_T of CSA doped PANi films